

# (12) UK Patent Application (19) GB (11) 2 289 812 (13) A

(43) Date of A Publication 29.11.1995

(21) Application No 9419866.0

(22) Date of Filing 03.10.1994

(30) Priority Data

(31) 9408582

(32) 29.04.1994

(33) GB

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(51) INT CL<sup>6</sup>

H04B 10/24 10/20, H04M 11/06 11/08, H04N 7/14  
7/22, H04Q 11/04

(52) UK CL (Edition N)

H4B BK20 BK24

H4K KOT

H4M MD

(56) Documents Cited

EP 0618692 A1 EP 0548409 A1 EP 0482943 A2  
JP 590216336 A JP 590216335 A US 5303229 A

(58) Field of Search

UK CL (Edition ) H4B BK BKX BK2 BK20 BK20S  
BK20S1 BK20S2 BK20T BK20T1 BK20T2 BK20T2B  
BK24, H4M MD ME, H4R RCC  
INT CL<sup>6</sup> H04B, H04M  
Online: WPI, INSPEC, CLAIMS, JAPIO

(54) Bidirectional communications

(57) A digital ATM communications system provides broadband services including television and video over fibre-coax and/or optical-fibre-to-the-house system to subscribers. The system incorporates carrier based transport for downstream telecom and video services and baseband transport for upstream telecoms and video. Quadrature phase shift keying (QPSK) modulation is employed for downstream telecoms and video transport.

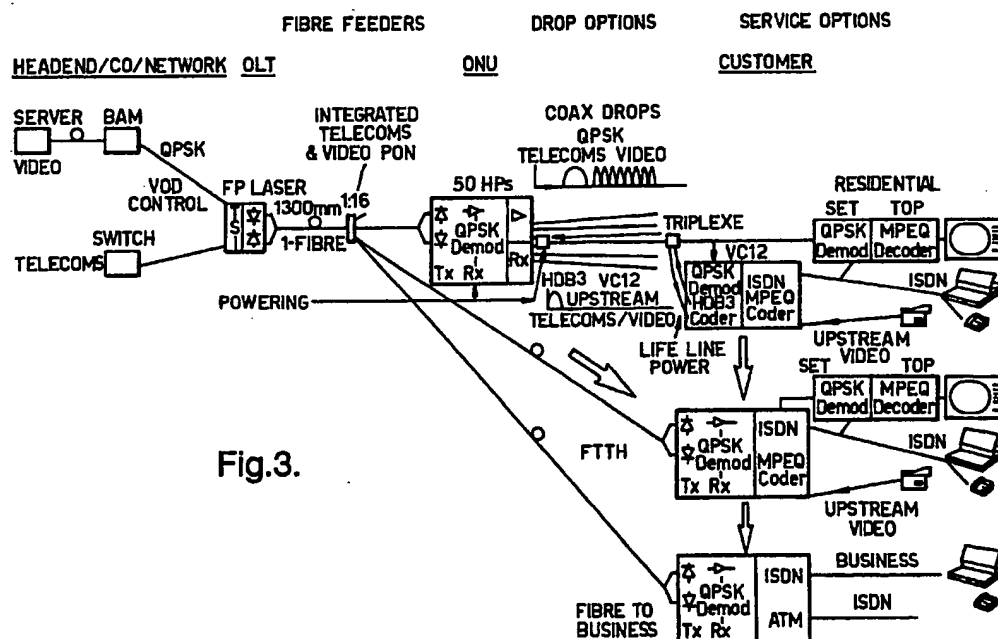


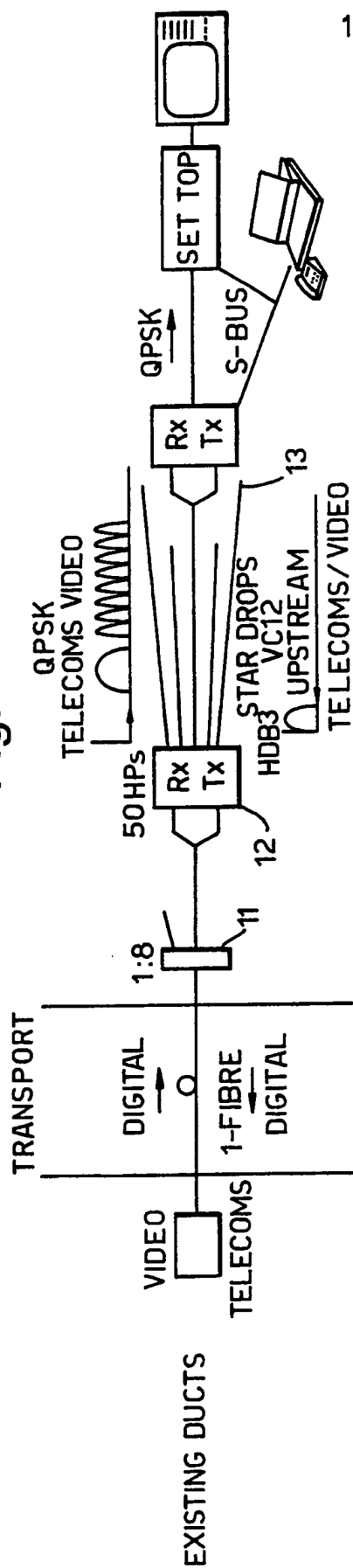
Fig.3.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

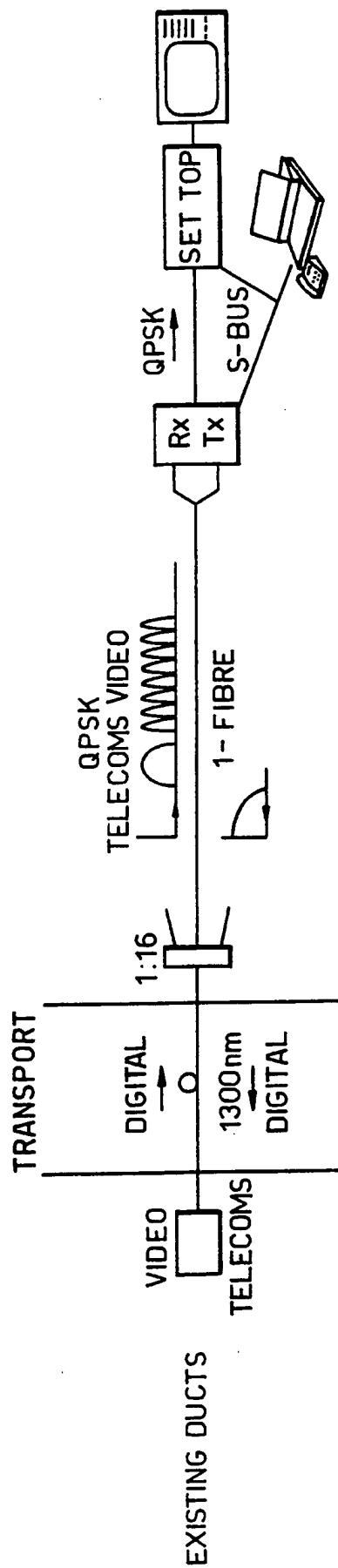
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Fig.1.



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Fig.2.



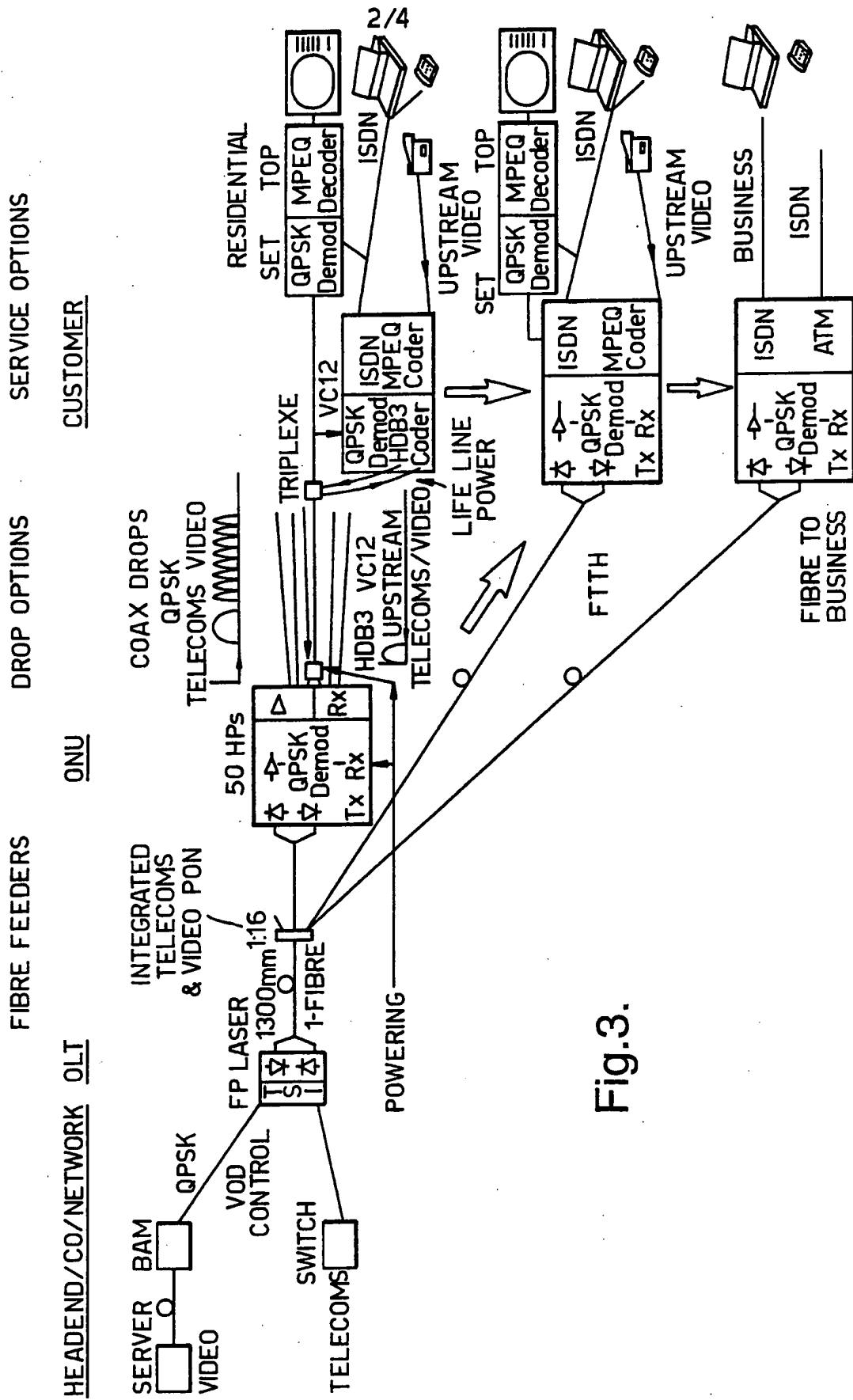


Fig.3.

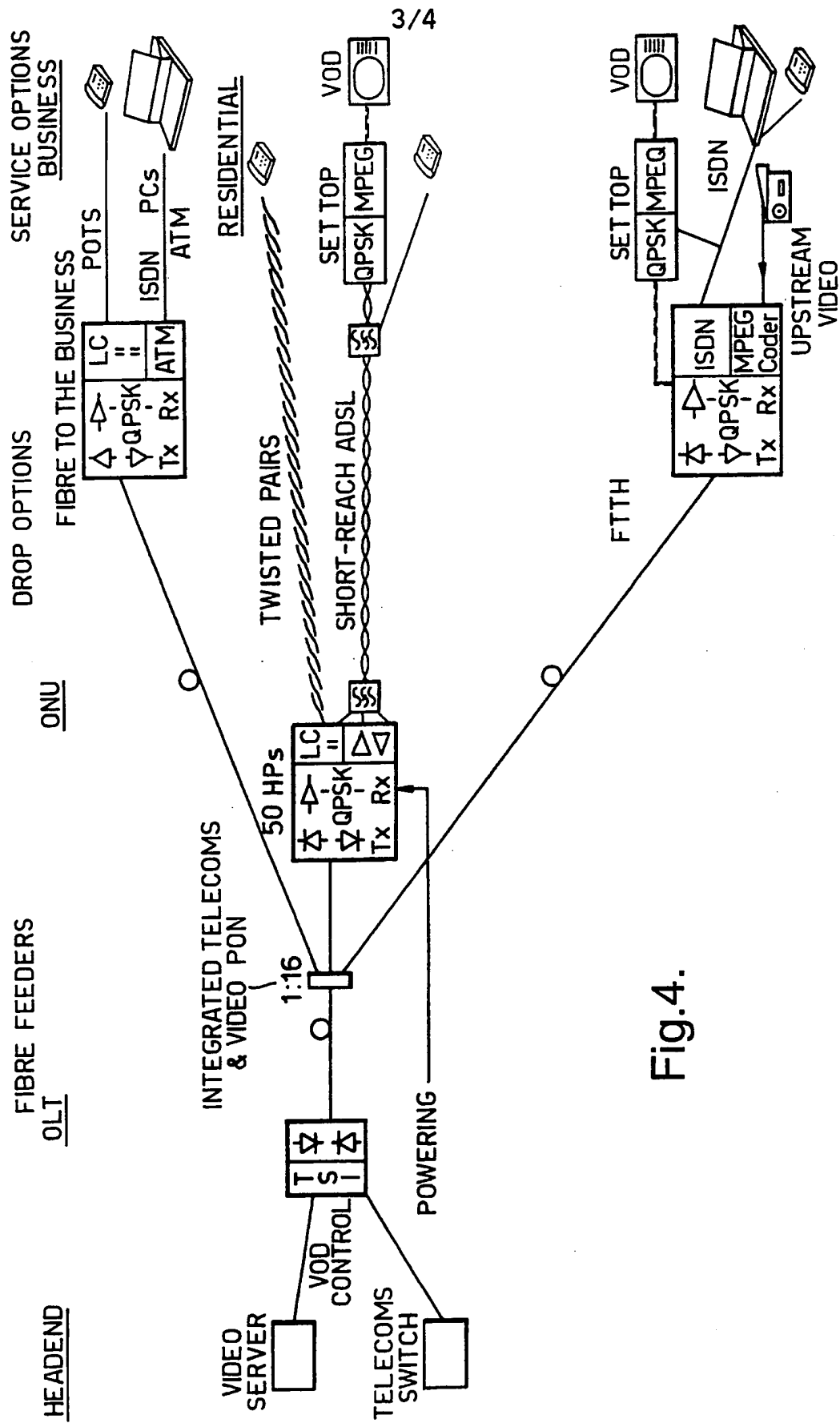
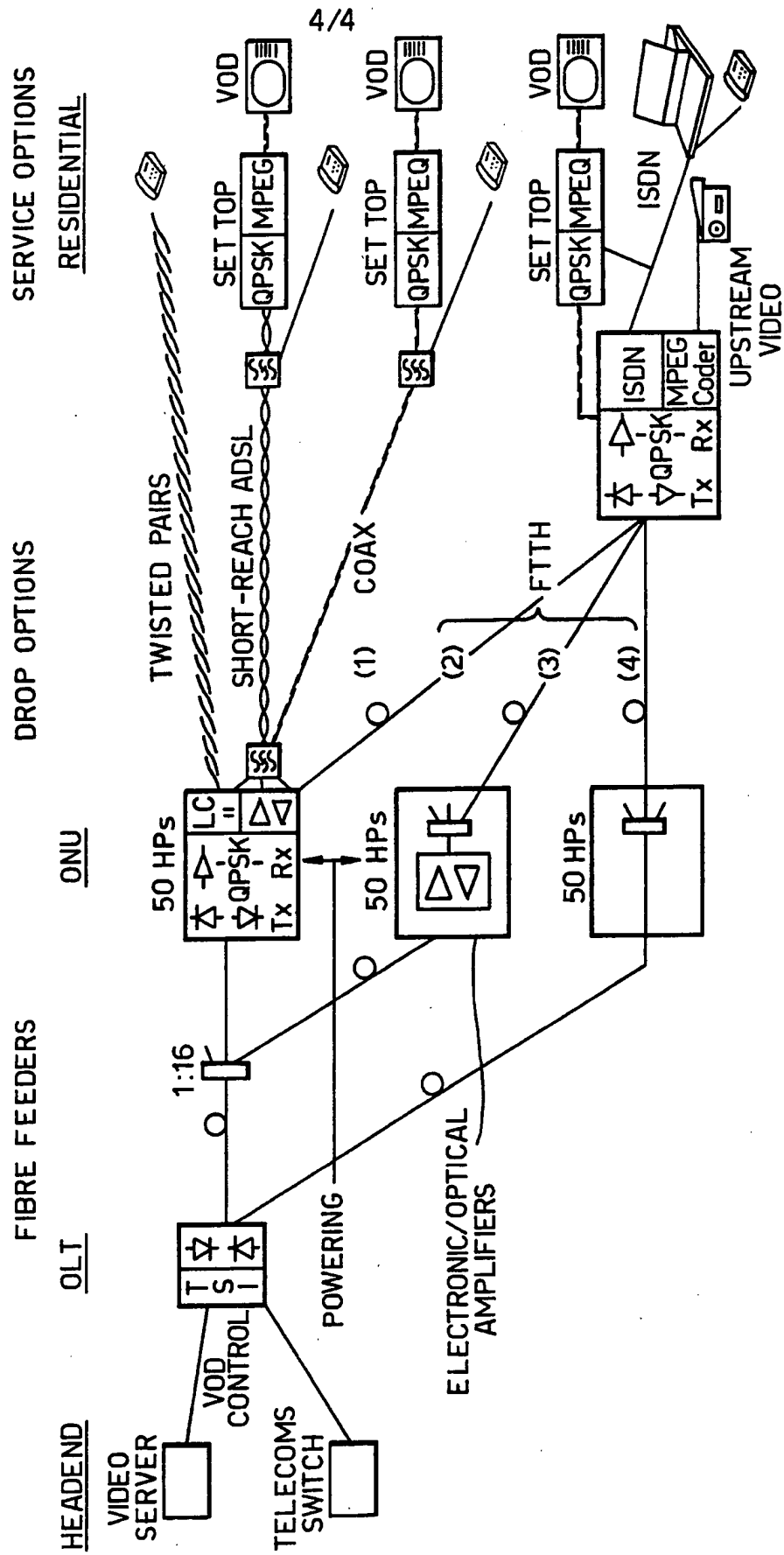


Fig.4.

Fig.5.



### **COMMUNICATIONS SYSTEM**

This invention relates to a communications system and in particular to systems supporting broadband services such as broadcast video and video-on-demand.

A wide range of narrowband and broadband services are currently available via telecommunications networks. The provision of the services has been greatly facilitated by the introduction of fibre in the loop (FITL) to support these services on a wideband optical carrier. At present, however, these services are generally limited to larger business premises where it is economic to provide a direct fibre connection to the network. It is generally considered uneconomic to provide direct fibre connections to residential subscribers although, as will be appreciated, the large majority of subscribers are either residential or are small business subscribers with a single line or only a small number of lines. There is thus a need to make the full range of services available to these subscribers at an economic cost.

The object of the invention is to provide a cost-effective network access to residential and to small business subscribers.

According to the invention there is provided a communications system providing broadband services including television and video over fibre-coax and/or fibre-to-the-house system to subscribers, the system incorporating carrier based transport for downstream telecom and video services.

In a preferred embodiment, quadrature phase shift keying (QPSK) modulation is employed for downstream telecoms and video transport.

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Star drops, especially for fibre/coax systems serving e.g. 30 to 60 residential subscribers with network powering and single upstream baseband transport, and integrated telecom and broadband fibre network together provide fibre/coax systems which are fully compatible with fibre to the home (FTTH).

The system uses carrier-based transport for downstream telecom and video services. Use of a passive optical network for fibre feeders allows a common optical network infrastructure with common ULT and ONU equipment.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:-

Fig. 1 is a highly schematic design of a telecommunications system providing broadband services to subscribers including domestic subscribers;

Fig. 2 shows an alternative system; and

Fig. 3 shows in more detail a system incorporating the arrangements of Figs. 1 and 2; and

Fig. 4 shows a further fibre access system; and

Fig. 5 illustrates various techniques for upgrading the system of Fig. 4 for broadband operation.

Referring now to Fig. 1 which depicts a fibre/coax system and to Fig. 3 which incorporates the system of Fig. 1 in more detail, broadband signals e.g. video signals together with telecom signals are carried via the system transport layer to a concentrator 11. The signals are carried in digital format, e.g. employing an ATM protocol, over a single fibre path. Signals in the forward direction are carried on a first optical wavelength, e.g. 1335nm, and the signals in the return direction are carried on a second wavelength, e.g. 1285nm.

The tributaries of the concentrator are coupled each to a local distribution unit 12 serving e.g. fifty residential subscribers each via a coaxial drop 13 terminating in a subscriber interface unit 14 which unit may comprise a triplexer. As illustrated in Fig. 2, the downstream services comprise a

telecom channel and a number of video channels employing QPSK modulation. Upstream telecoms to the concentrator video signals may be carried in a common channel using HDB3 coding.

The subscriber unit 14 feeds the QPSK video signal via a QPSK demodulator and a MPEG decoder to a video display 15. Telecom signals, e.g. ISDN traffic, are fed via a further QPSK demodulator to a terminal 16 and to a telephone 17. Upstream video services are fed via a MPEG codec and an HDB3 codec and via the coax drop for transmission to the network.

An alternative arrangement is shown in Fig. 2, the details of this arrangement being shown in the combined system of Fig. 3. In this arrangement the coaxial star drop arrangement is dispensed with and a direct fibre connection is provided to the residential subscriber.

A typical system will comprise the combined arrangement of Fig. 3. Coaxial drops will be provided in those situations where fibre connection may initially be precluded by cost. Where appropriate the coaxial drops may be replaced with fibre at a later date. This allows the system to take full advantage of developing technology.

Referring now to Fig. 4, this illustrates in schematic form a generic fibre access system. This arrangement is intended for PTOs who currently provide telecoms services to many customers over twisted pairs and who wish to continue using these in the near future. Figure 4 describes a network supplying larger business customers using fibre and small business and residential with twisted pair drops. Such a requirement can be met using PONs and a street ONU/multiplexer. The twisted pairs could initially carry baseband telecoms traffic yet can be upgraded for transport of asymmetric video for VOD, assuming short distance pairs of reasonable quality. The benefit of this solution is that the network, if based on a PON, can remain largely unchanged regardless of customer and final drop and could allow some FTTH connections also. Although some FTTH is possible in the arrangement of Fig. 4, it becomes more cost effective if a larger optical splitting ratio is employed. Most PON systems operate up to a split of 64 or more but many run out of bandwidth at these splits for broadband services. Calculations of bandwidths required for large PONs,

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taking the previously mentioned services and penetrations anticipated indicate that high bandwidths may be necessary. Some PON systems can operate with higher bit rates multiplexed electrically. Alternatively, most can operate using telecoms in the 1300nm window with broadband added at 1550nm when required, but WDM is normally more expensive. Typical service types and bandwidths are listed below:

Service Types	<u>Service Types and Bandwidths</u>	
	Bit Rates (per line)	
	<u>downstream</u>	<u>upstream</u>
Video-on-demand	3M/bs	64kb/s
Near VoD (staggercast)	3M/bs	-
Interactive Multimedia	3M/bs	3M/bs
Home shopping	3M/bs	64kb/s
Video-conferencing	2Mb/s	2Mb/s
Video-phone	384kb/s	384kb/s
Teleworking	2Mb/s	2Mb/s
Broadcast HDTV	20Mbs	-
Broadcast TV	3Mb/s	-
Video Games	2Mb/s	64kb/s
Virtual Reality	20Mb/s	2Mb/s
POTS	64kb/s	64kb/s

Once a generic fibre access system has been installed this can be further upgraded for broadband. This will require changes to customer drops and the street ONU, whilst minimising changes to the customers' equipment. Figure 5 illustrates four potential methods for upgrading to broadband.

Option (1) provides a simple approach to replace the twisted pair drops with coax. Merits are that the coax could reduce transport costs and yet still support a lifeline service from the ONU powering. A disadvantage is that coax, being metallic, may not have an unlimited life and might not be suitable in some European applications for aerial drops.

Option (2) uses a fibre to replace the twisted pairs to produce an active-star FTTH solution. This has the advantage of being all-fibre but introduces extra optics at the street ONU which may increase O&M costs and require street-sited switching for true broadband traffic.

Option (3) replaces the electronics in the street ONU by optical splitters and an electronic or optical amplifier to make up the shortfall introduced into the optical power budget by the additional splitting loss. This exploits the earlier investment in the street ONU cabinet, installation and powering but may require a change in optical window from 1300 to 1550nm.

Option (4) produces a truly passive PON FTTH solution which should have the lowest installed first costs and O&M costs. For minimum network costs it is preferable to increase the optical split ratio to at least 64. Larger splits, if required, are likely to require the use of optical amplifiers.

The systems described above have the advantage that, from installation, the passive optical network can carry ATM traffic in virtual packages. Later, as the network matures, the entire passive optical network can be ATM based.

**CLAIMS:-**

1. A communications system providing broadband services including television and video via an optical fibre transport network and over a fibre-coax and/or a fibre-to-the-house system to subscribers, the system incorporating carrier based transport for downstream telecom and video services and baseband transport for upstream telecom and video services.
2. A communications system as claimed in claim 1, wherein said downstream telecomms and video transport is effected via quadrature phase shift keying modulation.
3. A communications system as claimed in claim 1 or 2, wherein traffic on the optical fibre network is carried in a digital ATM format.
4. A communications system providing broadband services including television and video via an optical fibre transport network and over a fibre-coax and/or a fibre-to-the-house system to subscribers, the system comprising a head end from which said broadband services are in use provided, an optical fibre transport network, concentrators coupled to said network and to each of which a plurality of local distribution units are coupled, and a plurality of subscriber interface units coupled to each said local distribution unit via a coaxial star drop, and wherein the system incorporates carrier based transport for downstream telecom and video services and baseband transport for upstream telecom and video services.
5. A communications system substantially as described herein with reference to and as shown in figures 1 and 3, figures 2 and 3, figure 4 or figure 5 of the accompanying drawings
6. A method of operating a communications network substantially as described herein with reference to and as shown in figures 1 and 3, figures 2 and 3, figure 4 or figure 5 of the accompanying drawings



Application No: GB 9419866.0  
Claims searched: all

Examiner: E P Plummer  
Date of search: 16 March 1995

**Patents Act 1977**  
**Amended Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.N): H4B(BK,BKX,BK2,BK20,BK20S,BK20S1,BK20S2,BK20T,BK20T1,BK20T2,BK20T2B,BK24), H4M(MD,ME), H4R(RCC)  
Int Cl (Ed.6): H04B,H04M  
Other: Online:- WPI, INSPEC, CLAIMS, JAPIO

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X,P	EP0618692A1 SIEMENS eg abstract	1,2,4
X	EP0548409A1 ALCATEL eg abstract	1,4
X	EP0482943A2 NEC CORPORATION eg abstract	1,4
X	US5303229 WITHERS et al eg WPI abstract	1,4
X	Patents Abstract of Japan vol.9 no.85 (E-308)(1808) 13 April 1985 - equivalent to JP59216336A (Fujitsu)	1,4
X	Patent Abstracts of Japan vol.9 no 85 (E-308)(1808) 13 April 1985 - equivalent to JP59216335A (Fujitsu)	1,4
X	Electronics Letters vol.26 no.12, 7 June 1990 pages 827-828: G. Nicholson: Use of a fibre optic loop reflector as downstream receiver and upstream modulator in passive optical network - eg page 828, left column, paragraph 3	1,4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.